Dec. 10, 1957 E. G. BIANCA ET AL 2,815,568

PROCESS OF JOINING OR UNITING METALLIC SHEETS

Filed March 12, 1957

3 Sheets-Sheet 1

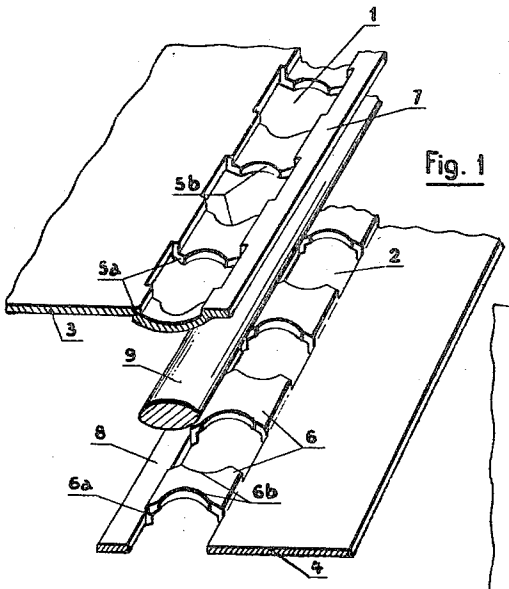


Fig. 1

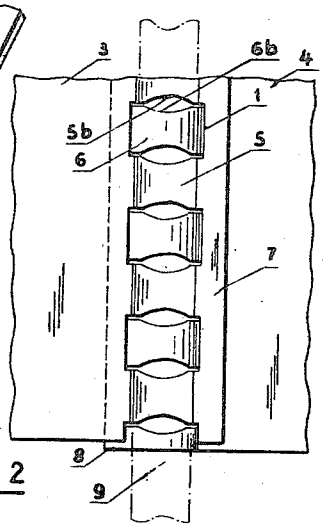


Fig. 2

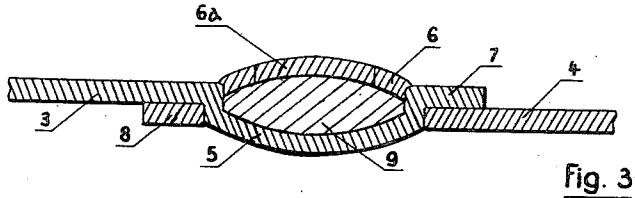


Fig. 3

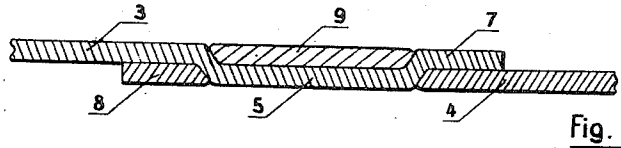


Fig. 4

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PROCESS OF JOINING OR UNITING METALLIC SHEETS

Filed March 12, 1957 3 Sheets-Sheet 2

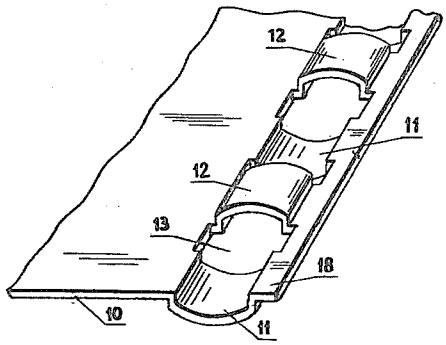


Fig. 5

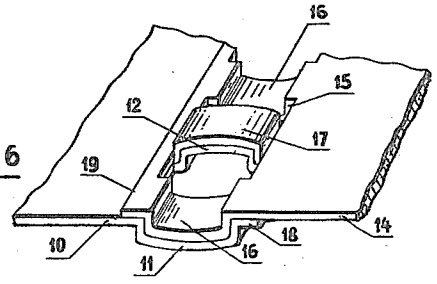


Fig. 6

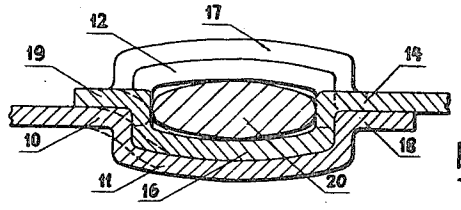


Fig. 7

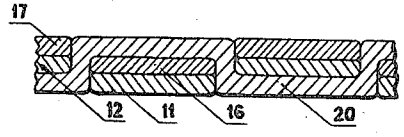


Fig. 8

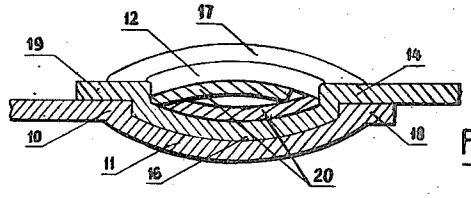


Fig. 7a

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PROCESS OF JOINING OR UNITING METALLIC SHEETS

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3 Sheets-Sheet 3

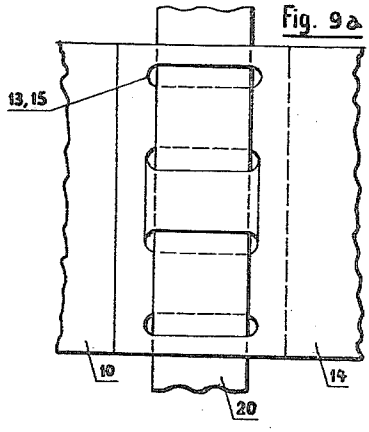


Fig. 9a

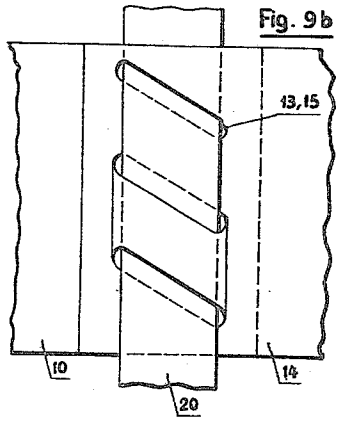


Fig. 9b

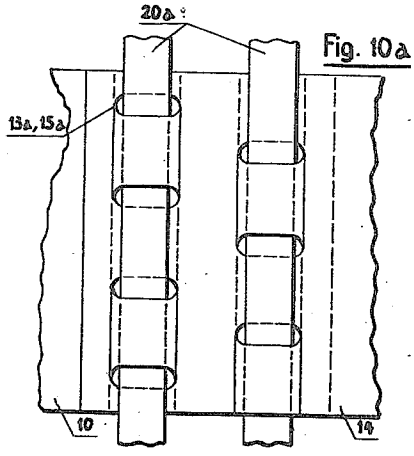


Fig. 10a

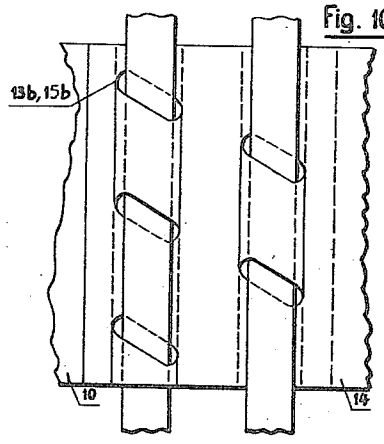


Fig. 10b

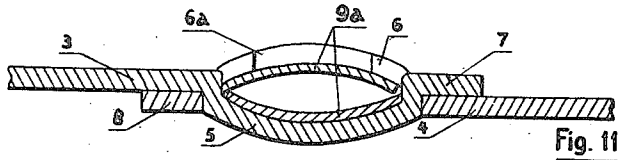


Fig. 11

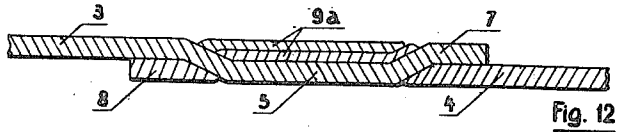


Fig. 12

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United States Patent Office 2,815,568 Patented Dec. 10, 1957

2,815,568

PROCESS OF JOINING OR UNITING METALLIC SHEETS

Edoardo Giuseppe Bianca, Zollikon, and Karl Diebold, Kilchberg, Switzerland

Application March 12, 1957, Serial No. 645,422

4 Claims. (Cl. 29—505)

Our invention relates to a process of joining or uniting metallic sheets. For instance it is possible to employ this process in uniting the overlapping edges of tubularly shaped metallic sheets in order to produce tubular masts or poles.

A process aiming at the same purpose is known in which the sheets are united by pairs of reciprocally engaging tongues. However, the work of fitting the seams together by meshing the tongues is extremely delicate and time consuming, and furthermore the resistance of the seam represents only a very low proportion of the sheet's strength.

The distinct process described herein consists in joining sheets by a seam-like connection by cutting out at least one row of openings in each metallic sheet in order to form series of straps, disposed transversely to the seam, between said openings, vaulting said straps out of the sheets' plane, inserting or fitting the seams of the two metallic sheets into each other in order to form at least one tubular channel constituted alternately by the vaulted straps of said first sheet and by the vaulted straps of said second sheet, introducing loosely a metallic locking-core into each of the channels, flattening finally the complete seam by beating or pressing and simultaneously forcing the locking-core into a wave-like shape not protruding from the seam.

The seam, although weakened to some extent by the openings cut out is reinforced by the locking core to such an extent as to approach the full strength of the sheet.

In the accompanying drawings we have illustrated a few examples of the process, but it will be understood that changes and alterations may be made in different applications without departing from the principles of the invention.

The figures show:

Fig. 1: an illustration of the overlapping edges of two metallic sheets with openings and straps ready for fitting together, as well as the locking-core.

Fig. 2: a plan view of the two sheets inserted into each other.

Fig. 3: a cross section of the inserted parts with the locking-core introduced.

Fig. 4: a cross-section of a finished seam built up by the parts shown in Figs. 1–3.

Fig. 5: an illustration of a second example.

Fig. 6: the two parts of the seam of the second example fitted into each other.

Figs. 7 and 7*a*: cross-sections of seams of the second example after introducing the locking-core but prior to flattening.

Fig. 8: a longitudinal section of seam according to Fig. 7 after flattening.

Figs. 9*a* and 9*b*: two variations of the example according to Figs. 5–8.

Figs. 10*a* and 10*b*: further variations of the example with double seams and

Figs. 11 and 12: cross sections of seams of a structure

analogous to Figs. 3 and 4, with an alternative type of locking-core.

As shown in Fig. 1, the openings **1** and **2** cut out of the sheets to be united **3** and **4** in order to form straps **5** and **6**. Straps **5** of sheet **3** are all vaulted out toward one side whilst straps **6** of sheet **4** are all vaulted into the opposite direction relatively to the former. The shaping of the straps is done preferably in such a way as to form shoulders **5***a* respectively **6***a* at the roots of the straps of a height corresponding approximately the thickness of the sheet. The width (measured in the direction of the seam) of the openings **1** and **2** is at least equal to the width of the straps **5** and **6** in order to permit an easy passage of the straps through the openings when the seam is fitted together. Straps **5** and **6** are preferably provided on their sides with arch-like or rectangular recesses **5***b* and **6***b* in order to offer space for the passage of the locking core after flattening the seam.

When prepared as described, the sheets **3** and **4** are inserted into each other by passing straps **5** of the upper sheet (in the drawing) down through the openings of the lower sheet, and simultaneously straps **6** of the lower sheet up through the openings of the upper sheet so that each strap passes through and beyond the other sheet. The marginal strip **7** of sheet **3** comes to match with sheet **4**, respectively strip **8** with sheet **3**. Thus a tubular channel is formed which is constituted alternately by a strap **5** of sheet **3** and a strap **6** of sheet **4**. A metallic locking core is then inserted into said tubular channel. This may be done either by pushing it in, or, for very long seams, pulling it through by means of a wire previously inserted and attached to said lock-core. This procedure is indicated equally where a close-fitting core is to be used or where small irregularities in the shape of the straps might render it difficult to push the core through.

The shape of the locking-core is adapted to the shape of the channel and its cross-sectional area in proper relation to the space it has to fill out after flattening the seam. It is preferably of a softer and more ductile material than the sheet in order to fill in completely the voids formed by the openings **1** and **2** and by the recesses **5***b* and **6***b*, as well as permit easy formation of the wave-like shape during flattening of the seam. This pressing or beating will in any case produce a hardening and strengthening effect on the material of the core, and should the final resistance be lower than that of the sheets, the difference may be compensated by choosing an appropriate width of the core. The final flattening of the seam by beating or pressing is preferably done by proceeding from one end of the seam to the other, or from the center towards the extremities. This will allow the core to pull in the length needed for forming the waves, instead of causing a plastic elongation. By this process a flat, even and strong connection of the sheets is obtained.

The basic process may be varied in practice in many ways. The solid, plastic type of core is preferably of lenticular or elliptic cross section, but may also be flat, and, in all cases, hollow instead of solid. Correspondingly the recesses **5***b*, **6***b* may be round or angular, with or without shoulders in the corners; straps **5**, **6** may be exactly in a right-angle position to the axis of the seam or they may be oblique to the same; shoulders at the roots of the vaults of the straps may be substituted by a smooth transition, all without affecting the basic principles.

Another example of practical application of this invention is shown by Figs. 5 and 10. Straps **11**, **12** of sheet **10** and straps **16**, **17** of sheet **14**, are formed respectively by the intervals between openings disposed in rows, as in the former example. The width of said openings,

however, is only approximately equal to the thickness of the locking core, and the straps are preferably several times wider than said openings. The straps of each row (and in each sheet) are then vaulted alternately downwards and upwards (in the drawing) and furthermore the straps **11** of the lower sheet **10** are vaulted down more deeply by about one sheet's thickness than straps **12** are vaulted up. Correspondingly straps **16** of the upper sheet **14** are less deeply vaulted down than straps **17** are vaulted up. In addition, the deeper straps **11**, **17** are longer by about two sheets' thicknesses than the shallower straps **12**, **16**. This permits to fit the two sheets **10** and **14** into each other by superposing individually a deep and a shallow strap, each successive pair **11—16** and **12—17** being vaulted out to a direction opposite to the preceding one.

A tubular channel is thus formed as in the preceding example, but it is built up by elements consisting of double, superposed straps, each of which belongs to a different sheet. The locking element and its application, as well as the finishing of the seam are exactly the same as described in the preceding example.

This type is recommended where very high seam-strength is required. By proper choice of shapes, dimensions and materials it is possible to obtain a strength very near to unity relatively to the full sheet, i. e. superior to welded seams.

Here again, many executional details may be varied without affecting the basic principles. Particularly the following points are susceptible to be modified: The roots of the straps may be shaped in a smooth and easy transition, as shown by the dotted lines in Fig. 7 (left hand side) without any shoulders, employing a core with lenticular cross section; the connection may be constituted by more than one seam as shown in Figs. 10*a* and 10*b*, using several cores **20***a*; the openings or slots **13**, **15** may either be in a rectangular position relatively to the seam as in Figs. 5, 6, 9*a* and 10*a*, or may be oblique as **13**, **15**, **13***b*, **15***b* in Figs. 9*b* and 10*b*. Lateral recesses in the straps are not required in this type, as the slot-like openings themselves will be properly dimensioned to provide passage for the core. It has been shown in practical tests that the highest seam strength is obtained with this type, employing slot-like openings of a width equal or slightly inferior to the thickness of the core, said slots being disposed obliquely at such an angle that will place one end of one slot in the same rectangular alignment, to the seam's axis, as the beginning of the following slot, as shown in Fig. 9*b*, since this permits the maximum ultilisation of the shear strength of the core, without creating local pressures above the yield point or shear point of the metal employed. In double seams distance between slots must be doubled in order to take advantage of this layout, as virtually the slot has been subdivided into two.

As for shape and material of the locking-core **20**, **20***a*, the same applies here as said for the previous example.

A further and in practice very useful and important variation in detail consists in employing a laminated locking core as shown in Figs. 7*a*, 11 and 12, which is applicable in all cases. The core is formed by two or more strips **20**, **9***a*, preferably of hollow shape such as to match closely the inner shape of the tubular channel formed by the straps **12** and **16**, respectively **5** and **6**. Each of said strips overhangs slightly on one of the edges thus facilitating a tight fit and complete filling up of the openings. The lamination offers less resistance to the wave-like formation during flattening and allows the use of harder and stronger material. The arched, hollow shape of the strips makes them expand laterally when flattened, exactly in the same way as the straps **11**, **12**, **16**, **17**, resp. **5**, **6** themselves, thus producing a completely sealed seam by completely filling out the openings, even with a comparatively hard material for the core. In this case, the sum of the thicknesses of the laminations is preferably approximately equal to the thickness of the sheets to be united.

The actual mechanical operations of producing seams as described are straightforward and can be carried out by existing and well known machinery and tools.

What we claim as new and desire to secure by Letters Patent is:

1. In a process of joining metallic sheets by a seam-like connection, cutting out at least one row of openings in each metallic sheet in order to form series of straps, disposed transversely to the seam, between said openings, vaulting said straps out of the sheets' plane, inserting or fitting the seams of the two metallic sheets into each other in order to form at least one tubular channel constituted alternately by the vaulted straps of said first sheet and by the vaulted straps of said second sheet, introducing loosely a metallic locking-core into each of the channels, flattening finally the complete seam by beating or pressing and simultaneously forcing the locking-core into a wave-like shape not protruding from the seam.

2. In a process of joining metallic sheets by a seam-like connection, cutting out at least one row of openings in each metallic sheet in order to form series of straps, disposed transversely to the seam, said openings possessing a width—measured in direction of the seam—at least equal to the width of the straps formed by their intervals, vaulting said straps of each row of each sheet out to one side only, inserting then the seams into each other by passing each vaulted strap of one sheet through the corresponding opening of the other sheet until the two sheets match together, in order to form at least one tubular channel constituted alternately by the vaulted straps of one sheet and the vaulted straps of the other sheet, inserting then loosely a metallic locking-core into said tubular channel, flattening finally the complete seam by beating or pressing and simultaneously forcing the locking-core into a wavelike shape not protruding from the seam.

3. In a process of joining metallic sheets by a seam-like connection, cutting out at least one row of openings in each metallic sheet in order to form series of straps, disposed transversely to the seam, said openings possessing a width measured in direction of the seam—smaller than the width of the straps formed by their intervals, vaulting out said straps of each row alternately to one side and to the opposite side, fitting then the seams into each other by placing alternate individual straps of each sheet into the corresponding hollows of straps of the other sheet vaulted in the same direction, in order to produce at least one tubular channel formed alternately by the superposed vaulted straps of both sheets, inserting then loosely a metallic locking-core into said tubular channel, flattening finally the complete seam by beating or pressing and simultaneously forcing the locking-core into a wave-like shape not protruding from the seam.

4. Process as claimed under 1, in which each of said locking cores is formed by at least two separate, transversely vaulted (hollow) strips, introducing each pair of said strips into said tubular channel with their concave sides turned towards each other.

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